Causes of injury and mortality of Fairy Pitta *Pitta nympha* on Jeju Island, Republic of Korea

EUN-MI KIM, CHANG-YONG CHOI & CHANG-WAN KANG

Introduction

The Fairy Pitta *Pitta nympha* is a migratory species known to breed only in mainland China, Taiwan, Japan and Korea (Lambert & Woodcock 1996, Brazil 2009). It is listed as Vulnerable in the IUCN Red List (BirdLife International 2001, 2013). As a summer visitor to Korea, arriving in early May and departing in October (Kim 1964), it breeds mainly in coastal forests and on some islands off the southern part of the Korean peninsula, although new breeding records have been reported inland (for example Gwangneung forest in Gyeonggi province and on Mt Gyeryong in Daejeon). Given that the species's breeding range extends to the Shandong peninsula, China, and there is a record in North Korea (Lambert & Woodcock 1996, Tomek 2002), the breeding range on the Korean peninsula may extend to other as yet unknown areas. Currently, Jeju Island, the most southerly part of Korea, is its most important known breeding area in the peninsula, since more than 60 pairs are believed to breed there regularly (Kim 2006).

The world population of Fairy Pitta numbers only a few thousand birds and is suspected to be in rapid decline due to deforestation and habitat loss in its breeding range together with hunting and human disturbance (BirdLife International 2001, 2013). In Taiwan, where there is a significant breeding population, poaching and habitat degradation and destruction were previously regarded as important threats to this species (Severinghaus *et al.* 1991), with habitat loss, including dam construction projects in key breeding areas, remaining as a key threat (BirdLife International 2013). In spite of the species's vulnerable status and general knowledge of the threats it faces, quantitative data on the pressures affecting the Fairy Pitta are poor, resulting in an information gap hampering conservation efforts.

Urbanisation, road construction and reclamation throughout Korea cause habitat degradation (Ministry of Environment 2002), but no specific threats to the Fairy Pitta in Korea have ever been identified or reported. Threat assessment, involving the identification, evaluation and ranking of threats to species or habitats of conservation interest, is an essential part of conservation planning and management (Rao *et al.* 2007). In this study, in order to provide the first quantitative data that may facilitate the development of a conservation strategy and mitigation measures for the threatened Fairy Pitta, threats to the species over the last decade were identified and prioritised by documenting causes of injury and mortality on Jeju Island.

Methods

The study area was the whole of Jeju Island (33.367°N 126.533°E), Jeju Special Self-Governing province, Republic of Korea; this oval-shaped volcanic island, located 80 km south of the Korean mainland and approximately 230 km west of Kyushu, Japan, is also part of the breeding range. It is believed that Fairy Pitta also stop over there during their spring and autumn migrations.

Field records and the rescue database of the Korea Association for Bird Protection, Jeju Branch, were examined for details of the injury and mortality of Fairy Pitta from 2002 to 2012 and the date, locality, habitat and age or developmental stage of each individual were recorded. Causes of injury and mortality were categorised as: head trauma caused by collision with windows or other man-made structures, dehydration, traffic accident, natural predation and disasters such as floods and human disturbance. The age or developmental stage of each individual was defined as: egg, chick, first year and adult. Four habitat types were identified: forest, urban, suburban and coastal.

Results

Thirty Fairy Pitta casualties were recorded on Jeju Island in the study period (Table 1, Figure 1). Of these, 22 (71%) resulted in death while eight injured birds survived and were rehabilitated. Six causes of

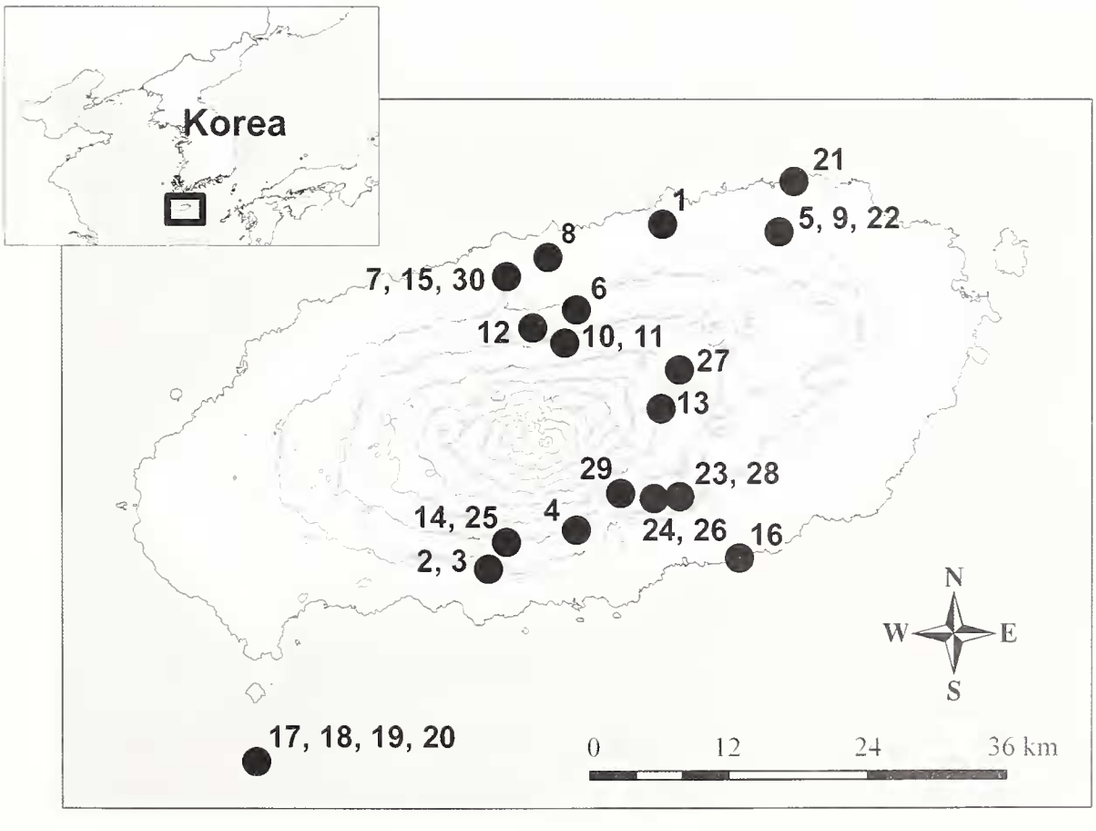

Figure 1. Locations of reported cases of dead or injured Fairy Pitta *Pitta nympha* from 2002 to 2012 on Jeju Island, Republic of Korea. Number at each location (filled circle) corresponds with the reports listed in Table 1.

injury and mortality were confirmed: predation by natural enemies (11 cases, 36.7%) and head trauma during window strikes (11 cases, 36.7%) were the most frequent causes, followed by traffic accidents (3, 10.0%), flooding (2, 6.7%), dehydration (2, 6.7%), and human disturbance (1, 3.3%). Fifteen casualties (50%) were attributed human activities, and the remaining cases were not.

Over the whole study period (2002–2012), most casualties were recorded during the time of migration and the early stages of breeding; monthly totals were: May, 8; June, 8, July, 9; August, 2; and September, 3. Casualties (17 cases) were most frequently reported in forests (the species's preferred habitat); five cases were recorded in coastal areas mainly during migration, and four cases were reported in urban and in suburban environments. Adult birds were most vulnerable, 18 cases (60%), followed by eight cases of egg destruction (26.7%), three cases involving first-year birds (10%) and only one case (3.3%) involved a chick.

Four predatory species were identified: Peregrine Falcon *Falco peregrinus*, Large-billed Crow *Corvus macrorhynchos*, Eurasian Magpie *Pica pica* and Steppe Rat Snake *Elaphe dione*. The main natural predators were Peregrine Falcons, which took five migrating adults, and Large-billed Crows, which predated 19 eggs from four nests (Table 1).

Discussion

Despite rapid infrastructure and resort development along the coast, the forests of Jeju Island have been well protected and managed for the past several decades (including strong natural and prescribed forest fire controls, no fuel-wood harvesting, and national park designation). Therefore, good habitat conditions for breeding Fairy Pittas on Jeju have been maintained, and thus habitat loss is not a major threat at this stage on the island (Kim *et al.* 2003). Neither hunting nor trapping was recorded during this study and predation and window strikes were found to be the most significant causes of injury and death.

Collisions between birds and man-made structures have been widely reported (Tanner 1954, Johnston & Haines 1957, Jones & Francis 2003, Martínez *et al.* 2010); in particular, collisions with windows can cause massive, non-selective mortality of birds (Klem 1990, Dunn 1993, Klem *et al.* 2004). Based on the 11 reported cases, window strikes were identified as the most serious threat to the pitta population on Jeju, other than natural predation. Just two buildings in forests caused 5 of the 11 window strikes. As the number of buildings in forests and the number and area of windows gradually grows, the threat of window strike also increases. Repeated incidences involving deaths of first-year birds at specific buildings in forests suggest that detrimental effects of window strike may be greater under certain conditions (e.g. when a high

Table 1. Fairy Pitta *Pitta nympha* injury and mortality records from 2002 to 2012 on Jeju Island, Republic of Korea.

No.	Date	Age class of pitta	Cause of injury and mortality	Outcome	Habitat	Related species
1	14 September 2002	Adult	Dehydration	Rehabilitated	Suburban	
2	23 June 2004	Adult	Car accident	Dead	Forest	Human
3	14 July 2004	Adult	Window strike	Rehabilitated	Forest	Human
4	2 July 2005	Eggs	Flooding	Dead	Forest	
5	7 July 2005	Adult	Window strike	Dead	Forest	Human
6	2 August 2005	1st year	Window strike	Dead	Suburban	Human
7	8 September 2005	Adult	Window strike	Rehabilitated	Urban	Human
8	27 May 2006	Adult	Window strike	Dead	Urban	Human
9	4 June 2006	Adult	Window strike	Dead	Forest	Human
10	28 June 2006	Eggs	Predation	Dead	Forest	Eurasian Magpie
11	17 July 2006	Eggs	Disturbance	Nest abandonment	Forest	Human
12	27 July 2006	Chick	Predation	Dead	Forest	Steppe Rat Snake
13	11 June 2007	Eggs	Predation	Dead	Forest	Large-billed Crow
14	29 July 2007	Eggs	Flooding	Dead	Forest	
15	21 May 2009	Adult	Dehydration	Rehabilitated	Urban	
16	24 May 2009	Adult	Predation	Dead	Coast	Peregrine Falcon
17	27 May 2009	Adult	Predation	Dead	Coast	Peregrine Falcon
18	27 May 2009	Adult	Predation	Dead	Coast	Peregrine Falcon
19	27 May 2009	Adult	Predation	Dead	Coast	Peregrine Falcon
20	27 May 2009	Adult	Predation	Dead	Coast	Peregrine Falcon
21	13 June 2009	Adult	Car accident	Dead	Suburban	Human
22	6 July 2009	Adult	Window strike	Dead	Forest	Human
23	15 June 2010	Eggs	Predation	Dead	Forest	Large-billed Crow
24	22 June 2010	Adult	Window strike	Rehabilitated	Forest	Human
25	9 July 2010	Eggs	Predation	Dead	Forest	Large-billed Crow
26	30 May 2011	Adult	Window strike	Dead	Forest	Human
27	14 June 2011	Adult	Window strike	Rehabilitated	Suburban	Human
28	19 July 2011	Eggs	Predation	Dead	Forest	Large-billed Crow
29	29 August 2012	1st year	Car accident	Rehabilitated	Forest	Human
30	14 September 2012	1st year	Window strike	Rehabilitated	Urban	Human

proportion of reflective windows have been used). Traffic accidents may cause local wildlife mortality (Hell *et al.* 2005, Gryz & Krauze 2008, Litvaitis & Jeffrey 2008), but such accidents (3 cases) were less frequent than collisions with windows. Nevertheless, head trauma caused by human-related accidents was the main cause of mortality or the main reason for rescuing pittas on the island.

The high proportion of adult birds involved in accidents, including nine window strike cases, may be significant in terms of impacting the pitta population on Jeju. The small proportion of casualties involving first-year birds, on the other hand, possibly suggests a lower mortality rate or higher survival rate of juveniles at least in natal areas, once they have successfully fledged avoiding predation and floods.

Most casualties were in the spring and early summer from May to July, coincident with the species's spring migration and the most active part of the breeding season for adults (Kim 1964, Kim *et al.* 2003); fewer casualties were reported during the autumn migration in October (Kim 1964, Kim *et al.* 2003). The spring migration coincides with the breeding season of Peregrine Falcons in coastal areas around Jeju Island, and many Fairy Pittas thus seem to be exposed to the danger of predation by Peregrines during their final sea-crossing to the island—a breeding pair of Peregrines on Mara islet killed four pittas in one day (Table 1), suggesting that natural predation during migration may have a significant effect.

Although predation is a natural ecosystem process, the observed rate of nest predation by corvids, including one case by a Eurasian Magpie—a species introduced into Jeju as recently as 1989— may not be entirely natural. Corvids are often attracted to garbage and invade forests along roads and man-made trails. Only one case of nest abandonment resulting from human disturbance (photographers) was reported. However, given the indirect effects of humans on corvid behaviour and distribution, the overall proportion of anthropogenic causes of mortality and nest failure may be higher than that of natural causes.

These results identifying current threats to the Fairy Pitta suggest several mitigation measures for this threatened species on Jeju:

1. Preventing window strikes is the most urgently required mitigation. This may include the identification of buildings threatening local populations and the use of typical anti-collision methods there (Dunn 1993, Klem *et al.* 2004): habitat modification, physical barrier setting, glass angling and glass patterning using bird saving stickers may all be appropriate. However, restriction on the construction of new buildings in key breeding areas must be a more fundamental solution. Pitta occurrence and numbers, and the expected effects of building construction on the species should be included in environmental impact assessment procedures on Jeju, particularly in forested areas. Developing new building regulations to limit the size or total area of windows in forested areas is applicable, and this kind of regulation would be more realistic and successful when the greater energy efficiency of buildings with smaller areas of window is also considered.
2. The construction of new roads or trails should be restricted in key breeding areas. This may also minimise traffic accidents with other key wildlife species, such as the Jeju Roe Deer *Capreolus pygargus*. More importantly, fewer and shorter roads and trails may reduce the access of newly introduced exotic predators (e.g. Eurasian Magpies) into pitta breeding habitat.
3. Predator control within pitta breeding habitat should be considered, with two common corvids, the native Large-billed Crow and the introduced Eurasian Magpie, as the main targets of the programme. Corvid control may mitigate the detrimental effects of predation on threatened species (Peery & Henry 2010). Specifically, the increasing numbers of invasive Eurasian Magpies at higher altitude and in forested areas should be controlled and managed as the highest priority.
4. Human disturbance at nesting sites should be minimised; although nest abandonment resulting from disturbance was recorded only once during this study, human access to nests may incidentally increase the predation risk. Construction or forest management (such as thinning and felling) near known nesting sites should only be carried out outside the breeding season. Access by inexperienced photographers should also be controlled. Strict adherence to the current domestic legislation relating to this species (Endangered Species Class II under the Protection and Management of Wildlife Act, and Natural Monument #204 under the Cultural Heritage Protection Act) (Ministry of Environment 2002) and to protected areas such as Mt Halla National Park should also be enforced.

In conclusion, in addition to the known threats to Fairy Pitta populations including habitat loss and lowland deforestation (BirdLife International 2013), the results of this study lead us to suggest that human-related mortality, including window strikes and traffic accidents as well as predation, may adversely and significantly affect the survival of individual Fairy Pittas, raising new conservation concerns in human-dominated environments.

Acknowledgements

We thank all members of the Jeju Wildlife Research Centre and the Korea Association for Bird Protection, Jeju Branch, for their support. We also thank Mark Brazil for his assistance in the preparation of the final draft of the manuscript.

References

BirdLife International (2001) *Threatened birds of Asia: the BirdLife International Red Data Book*. Cambridge UK: BirdLife International.

BirdLife International (2013) Species factsheet: *Pitta nympha*. Downloaded from http://www.birdlife.org on 19/01/2013.

Brazil, M. (2009) *The birds of East Asia*. London: Christopher Helm.

Dunn, E. H. (1993) Bird mortality from striking residential windows in winter. *J. Field Orn.* 64: 302–309.

Gryz, J. & Krauze, D. (2008) Mortality of vertebrates on a road crossing the Biebrza Valley (NE Poland). *European J. Wildl. Res.* 54: 709–714.

Hell, P., Plavý, R., Slameèka, J. & Gašparík, J. (2005) Losses of mammals (Mammalia) and birds (Aves) on roads in the Slovak part of the Danube Basin. *European J. Wildl. Res.* 51: 35–40.

Johnston, D. W. & Haines, T. P. (1957) Analysis of bird mortality in October 1954. *Auk* 74: 447–458.

Jones, J. & Francis, C. M. (2003) The effects of light characteristics on avian mortality at lighthouses. *J. Avian Biol.* 34: 328–333.

Kim, E. M. (2006) The distribution and breeding ecology of Fairy Pitta (*Pitta nympha*) on Mt. Halla. In Research Institute for Mt. Halla. *Report of survey and study of Hallasan Natural Reserve in 2006*. Jeju: Jeju Special Self-Governing Province.

Kim, E. M., Oh, H. S., Kim, S. B. & Kim, W. T. (2003) The distribution and habitat environment of Fairy Pitta (*Pitta nympha* Temminck & Schlegel) on Jeju Island, Korea. *Korean J. Orn.* 10: 77–86.

Kim, H. K. (1964) The ecology of Fairy Pitta. *Korean Culture Research Institute Bull.* 5: 235–240.

Klem, D. Jr. (1990) Collisions between birds and windows: mortality and prevention. *J. Field Orn.* 61: 120–128.

Klem, D. Jr., Keck, D. C., Marty, K. L., Ball, A. J. M., Niciu, E. E., & Platt, C. T. (2004) Effects of window angling, feeder placement, and scavengers on avian mortality at plate glass. *Wilson Bull.* 116: 69–73.

Lambert, F. & Woodcock, M. (1996) *Pittas, broadbills and asities*. Sussex: Pica Press.

Litvaitis, J. A. & Jeffrey, P. T. (2008) An approach toward understanding wildlife-vehicle collisions. *Environmental Management* 42: 688–697.

Martínez, J. E., Calvo, J. F., Martínez, J. A., Zuberogoitia, I., Cerezo, E., Manrique, J., Gómez, G. J., Nevado, J. C., Sánchez, M., Sánchez, R., Bayo, J., Pallarés, A., González, C., Gómez, J. M., Pérez, P. & Motos, J. (2010)

Potential impact of wind farms on territories of large eagles in southeastern Spain. *Biodiversity and Conservation* 19: 3757–3767.

Ministry of Environment (2002) *White paper of environment 2002*. Gwacheon: Korean Ministry of Environment.

Peery, M. Z. & Henry, R. W. (2010) Recovering marbled murrelets via corvid management: a population viability analysis approach. *Biol. Conserv.* 143: 2414–2424.

Rao, M., Johnson, A. & Bynum, N. (2007) Assessing threats in conservation planning and management. *Lessons in Conservation* 1: 46–71.

Severinghaus, L. L., Liang, C. T., Severinghaus, S. R. & Lo, L. C. (1991) The distribution, status and breeding of Fairy Pitta (*Pitta nympha*) in Taiwan. *Bull. Institute of Zoology, Academia Sinica* 30: 41–47.

Tanner, J. T. (1954) Bird mortality during night migration: October 1954. *Migrant* 25: 57–68.

Tomek, T. (2002) The birds of North Korea: Passeriformes. *Acta Zoologica Cracoviensia* 45: 1–235.

***Eun-Mi KIM**, Department of Biology, Jeju National University, Jeju, Jeju province 690-756, Republic of Korea & Warm-Temperate and Subtropical Forest Research Center, Korea Forest Research Institute, Seogwipo, Jeju province 697-050, Republic of Korea. Email: kptta@naver.com*

***Chang-Yong CHOI**, Research Institute for Agriculture and Life Sciences, Seoul National University, Seoul 151-921, Republic of Korea. Email: subbuteo@hanmail.net (corresponding author)*

***Chang-Wan KANG**, Korea Association For Bird Protection-Jeju Branch, Seogwipo, Jeju province 697-340, Republic of Korea. Email: jejubirds@hanmail.net*

House Crow *Corvus splendens* nesting on pylons, Kutch district, Gujarat, India

A. MOHAMED SAMSOOR ALI, S. RAMESH KUMAR & P. R. ARUN

Introduction

During the past 50 years, electric power transmission lines have become a conspicuous part of the landscape of industrialised countries. These powerlines and their supporting structures (pylons) are known to cause avian mortality, and in recent decades this has been increasingly documented throughout the world (Bevanger 1994, Brown & Drewien 1995, Winning & Murray 1997, Janss & Ferrer 2000, Sundar & Choudhury 2001, Shaw *et al.* 2010, Tere & Parasharya 2011). A recent review summarised some adverse effects of the electromagnetic fields around powerlines on avian reproductive biology and physiology (Fernie & Reynolds 2005). In contrast, power cables and supporting structures in open habitats benefit some bird species by providing perches offering commanding views of hunting areas (Lammers & Collopy 2007, Asokan & Ali 2010) and nest sites (Brown & Lawson 1989, Steenhof *et al.* 1993, Infante & Peris 2003). The use of these structures for nesting purposes is a fairly recent development and has enabled some species to expand their breeding ranges into areas where there are no natural nesting sites.

Published literature on the use of pylons (large vertical steel towers supporting high-tension powerlines) for nesting by Indian birds is sparse. Here, we report on House Crow *Corvus splendens* nesting on pylons in Kutch district, Gujarat, India. House Crows typically build stick nests, usually in large trees with spreading crowns, but nesting on pylons is a relatively recent phenomenon.

Materials and methods

The study was conducted in and around the Samakhiali region (23.303°N 70.507°3E) of Bhachau Taluk, Kutch district, in June and July 2012. The study area is flat terrain with scanty vegetation dominated by agricultural fields and human settlements with several scattered waterbodies of varying sizes. The area has a

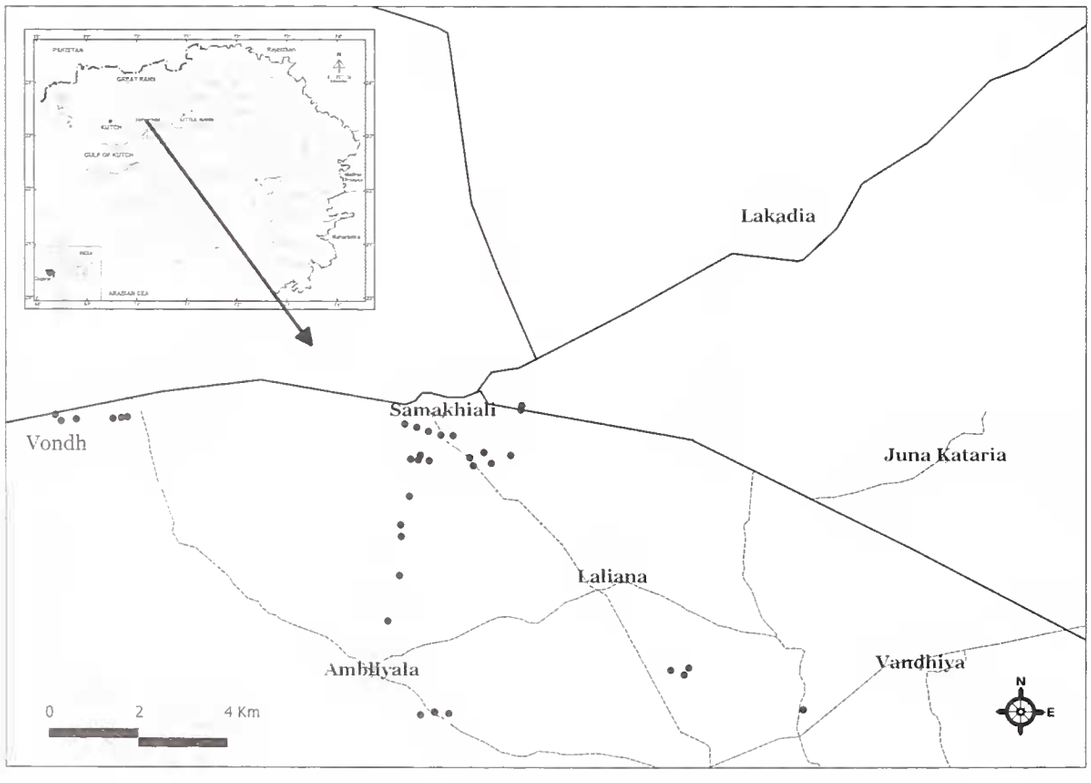

Figure 1. Map of the study area showing the localities of House Crow nest sites on pylons (black dots).